RISK MANAGEMENT STANDARD

EGPC-PSM-ST-001

PSM STANDARDS

The Egyptian Process Safety Management Steering Committee (PSMSC Egypt)
PSM TECHNICAL SUBCOMMITTEE (PSMTC)

Acknowledgements

This publication has been produced as a result of the comprehensive efforts carried out by the PSM Technical subcommittee on behalf of the Egypt PSM steering committee, formed per the Memorandum of Understanding signed between the Ministry of Petroleum and Mineral Resources and Methanex Egypt in February 2020 overseeing the design and implementation of a detailed PSM program to promote and enhance PSM culture for MOP and its affiliated companies following industry best practice, international codes and standards. The Egyptian Process Safety Management Steering Committee is formed of representatives from MOP, EGPC, ECHEM, EGAS, Ganope and Methanex Egypt.

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During developments and prior approval, all PSM technical subcommittee documents are subjected to a thorough technical peer-review process. The PSM technical subcommittee gratefully appreciates the thoughtful comments and suggestions of the peer reviewers. Their contributions enhanced the accuracy and clarity of the documents.

The PSM technical sub-committee acknowledges the following reviewers from major Process Safety consultants as well as major operators & EPC who provided valuable comments during the technical peer reviews that resulted in an outstanding product structure and quality:

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All administrative queries must be directed to the Egyptian Process Safety Technical Subcommittee.

Table of Contents

1. Introduction

The Oil and Gas industry has hazards and risks that are inherent to its workers, environment, public, assets, activities, operational locations, and products. Using a standardised approach to risk management, that is applied consistently across all types of operation, has the advantage of accounting for different sources and types of risk (including, but not limited to, consideration of the potential consequences of environmental impacts, security threats, community grievances and capability scarcity, as well as personal and process safety incidents).

The EGPC and Egyptian Oil and Gas Holding Companies' HSE Policy mandates that its COMPANIES are committed to "Pursuing no harm to people and the community" and "Protecting the environment" and makes commitments to managing risks through effective controls and minimizing impacts on business and sets an overall context and leadership commitment in managing HSE risks. This means that all activities must be conducted in a manner designed to minimise HSE risks, protect the health and safety of employees, contractors, customers, the community at large and the environment.

COMPANIES, through the active participation of all employees and contractors, shall strive to manage HSE risks to prevent incidents, injuries and occupational illnesses, progressively minimising environmental impact by reducing discharges, using energy efficiently and producing safe, quality products. ENTITIES shall enforce their COMPANIES to manage all risks to As Low as Reasonably Practicable (ALARP).

2. Purpose

The purpose of this standard is to establish a structured Risk Management process and consistent method of ranking the severity and probability of potential hazards to ensure that risks are identified, analysed, evaluated and treated consistently and assigned to a respective management tier for implementation, follow-up and closure. It seeks to help prioritize resource allocation and defines endorsement levels to manage levels of risk. To achieve this objective, this standard aims to provide a framework for:

- Using a consistent language that is understood across the subsidiaries and operating companies managed by the ENTITIES.
- Defining a unified Risk Assessment and Management System Framework for the ENTITIES including a unified Corporate Risk Matrix for all HSE and Business risk assessments.
- Specifying methods and tools for effectively identifying hazards, risk analysis and evaluation using the Risk Tolerability criteria defined in this standard related to ENTITIES' activities.
- Setting consistent risk tolerability criteria for qualitative, semi-quantitative and quantitative risk assessments in line with ENTITIES' Corporate Risk Matrix.
- Aiding robust and informed decisions making for management of HSE risk consistently across ENTITIES and their COMPANIES.
- Notifying risks and endorsing risk management measures, including additional actions if applicable, consistently at the appropriate levels of the organization.
- Monitoring the effectiveness of any risk management measures.

Unless otherwise stated, all of the requirements set out in this Standard are Mandatory and it is the responsibility of senior management of each subsidiary, business unit and/or affiliated operations to ensure that these are implemented throughout the facilities that fall under their sphere of influence and, that contractors and subcontractors working on their facilities are fully aware and compliant with these requirements.

3. Scope

This document stipulates the mandatory requirements applicable to the Egyptian General Petroleum Corporation (EGPC) and Oil and Gas Holding Companies, including the Egyptian Natural Gas Holding Company (EGAS), the Egyptian Petrochemical Holding Company (ECHEM) and the South Valley Petroleum Holding Company (GANOPE) covering all of their operational subsidiaries, state-owned companies, affiliates and joint ventures.

ENTITIES and their COMPANIES and contractors shall ensure that all requirements listed herein are fully understood, implemented, complied with and monitored at all times including current operations, existing and future projects during the whole projects' lifecycle from feasibility till decommissioning.

4. Definitions & Abbreviations

ENTITIES: hereinafter are used to indicate EGPC and Holding Companies i.e., EGAS, ECHEM and GANOPE that are required to enforce implementation of this standard across their COMPANIES.

COMPANIES: hereinafter are used to indicate operating company, subsidiary, affiliated, Joint Venture companies that are required to comply with ENTITIES' standards.

For other definitions and abbreviations, refer to PSM Glossary document EGPC-PSM-GL-011.

5. Laws and Regulations

Currently, there are no Egyptian laws or regulations that specify in detail the risk management requirements. However, some articles in Labour law and the Environmental law are relevant in that the consequences of a hazard may result in either adverse environmental impacts or effects on people including but not limited to the following:

- Labour Law 12 of 2003 (Book Five), Articles 208, 209, 210, 211, 212, 213, 214, 215, 217, 219.
- Minister of Manpower Decree no. 211 of 2003.
- Law no. 59 of 1960 regulating the work with ionizing radiations and preventing its hazards.
- Minister of Health Decree no. 265 of 1989 regarding prevention measures in the field of industrial radiographic photography.
- Law no. 7 of 2010 regulating nuclear and radiological activities.
- Prime Minister Decree no. 1326 of 2011 to issue the executive regulations of Law no. 7 of 2010.
- Law 93 of 1962 regarding the disposal of liquid waste, and the Decree of the Minister of Urban Communities no. 44 of 2000 regarding the disposal of liquid waste.
- Law 48 of 1982 regulating the protection of the Nile and waterways from pollution.
- Law no. 55 of 1977 regarding the establishment and management of thermal machines and steam boilers, and Decree no. 154 of 2007 Resolution to amend some provisions of the executive regulations of Law 55 of 1977.
- Law no. 4 for 1994 and its amendments by law no. 9 for 2009 and law no. 105 for 2015 and their executive decrees.

ENTITIES must ensure that their COMPANIES comply with all relevant Egyptian laws and regulations at all times, including any laws that may be introduced after the publication of this standard.

6. Roles, Responsibilities, and Governance Structure

To ensure risks within ENTITIES are consistently managed by the approach outlined in this standard, and COMPANIES shall create and sustain an organization that supports and is conducive to the management of risk. The governance structure is as shown in Annex H - Risk Management Review Committees while roles and responsibilities are outlined in Annex G - Roles and Responsibilities.

7. Requirements

Risk management can only be achieved through the management of known and potential hazards and risks. This requires the definition of a Risk Assessment and Management System. Within the IOGP Operating Management System (OMS) Framework shown in Figure 1 and its OMS Implementation Guideline adopted by EGPC, risk management is an integral part of many of the organization's macro processes and, at the same time, it is central to decision-making within the OMS, explicitly addressing uncertainty to protect the company and its stakeholders.

Figure 1: OMS, Element 5 – Risk assessment and control (IOGP, 2014)

7.1. Risk Management Process

Risk Management is an integral part of the organization management system, decision-making process, and is integrated into the structure, operations, and processes of the ENTITIES and their COMPANIES.

ISO 31000; Risk Management Standard, provides the framework and process of managing risks. While ISO 31010; Risk Assessment Techniques, provides a list of tools that can be applied regardless of the size and scale of the companies. The applicability of risk assessment techniques to the ISO 31000 process is well described in the ISO 31010.

Figure 2 provides the framework and process of managing risk in COMPANIES during its lifecycle and includes a customized list of Risk Management techniques that can be used to ensure proper and sound risk management.

Figure 2: Application of techniques in the ISO 31000 risk management process (ISO 31010, 2019)

Note: these techniques are indicatives and should be used based on the nature of the facility, operation, and project phase; align with process safety studies in Major Projects Guidelines EGPC-PSM-GL-002

7.2. Risk Management Process Requirements

- Chairman and Managing Director(s) of each COMPANY belonging to any of the ENTITIES shall be accountable for conformance to the requirements of this Standard.
- Each COMPANY that belongs to any of the ENTITIES shall:
  - identify the risks relevant to its accountabilities across the types of risks (e.g., Process Safety, Occupational Health & Safety, Environmental and Compliance);
  - identify, assess, respond to and monitor risks in accordance with this Standard;
  - assess the level of risks based on a Worst Credible accidental scenarios for each of the applicable severity and likelihood criteria defined in Annex A - Corporate Risk Assessment Matrix;
    The extent (breadth and depth) of risk assessment is proportionate with the impact level and type of risk and the nature of the impacts. The extent of risk assessment may range from a professional judgment to a formal quantified risk assessment.
  - produce their internal Risk Assessment Matrix based on severity and likelihood criteria defined in Annex A - Corporate Risk Assessment Matrix with only allowable changes to financial impact criteria reflecting their asset value and annual production or profit plans according to the percentage identified in Table 4 for financial impact;
  - follow risk management measures according to Annex E - Risk Control Measures;
  - document the risks they are accountable for and how they are managed;
  - establish and maintain a Risk Register and Risk Action Plan for each Level 1 (Red), Level 2 (Amber), and Level 3 (Yellow) risks as per Annex D - Risk Register and Action Plan Template; and,
  - notify and endorse risks Risk Register and Action Plan – at a minimum – to the levels defined in Annex I - Signoff requirements for various residual risk levels, based on the highest residual risk rating determined by the colours on the risk matrix.
    Significant changes to risks and their management shall be notified and endorsed respectively at the levels defined in levels consistent with the colours on the Corporate Risk Matrix.
- Where improvements are needed to the management of risks, additional actions with owners, timelines for completion and resources required shall be developed and implemented.
  Additional actions can be developed and prioritised based on the risk assessment, strength of existing risk management measures, strategy and plans, legal and regulatory requirements and any other factors that could affect timing.
  To help decide whether improvements are needed, consider whether the risk is sufficiently managed by existing risk management measures. This could include reference to applicable ENTITIES' requirements, laws, regulations and proven practices in the industry.
- Risks and the effectiveness of risk management measures shall be
  - specific, Measurable, Achievable, Time framed (SMART)
  - be referred to best available data or expert judgement, and
  - monitored to an appropriate extent, reviewed and updated frequently as identified in Annex H - Risk Management Review Committees.
    The extent and how often risk monitoring is conducted is proportionate with the level and type of risk and the nature of the impacts.
- Annex F - Risk Assessment Fundamentals guides the key steps and expectations of a risk assessment process that might be applied.

7.3. Establish Context

Before starting any operation or project, it is important to establish the context and assess the risks. There should be a clear understanding of the technical objectives, scale of operations, geographic location and timeframe. Taking this into consideration, as well as any relevant stakeholder input, all potential consequences should be assessed. The likelihood of occurrence of a hazard and the potential severity of a consequence is used to assess the level of risk. A realistic view can then be taken of the worst-case, credible outcome of a scenario, taking into account the extent to which severe consequences can be foreseen, particularly those with a low likelihood of occurrence.

The general approach to risk management starts by considering both external and internal contexts. External context may include social, cultural, economic, regulatory and environmental aspects at local, regional, national or international levels; and how these affect the company's objectives and its relationships with stakeholders. Internal context may include how the company is organised and governed, its policies and objectives, capabilities and resources, information and decision-making systems, contractual and partnering relationship, and its culture.

7.4. Hazard Identification and Screening

For hazards associated with the activities throughout the life cycle of COMPANIES belonging with any of the ENTITIES, all threats and causes that could lead to potentially hazardous events resulting in undesirable consequences shall be systematically identified.

Hazard Identification is the first step in the risk assessment process. This can be done using structured techniques, such as HAZID, HAZOP, HITRA, etc.

In projects, the Guideline for Process Safety Studies for Oil, Gas and Petrochemical Projects EGPC-PSM-GL-002 shall be adopted, whereas emerging risks during the operations phase are assessed according to its risk level as shown in the Risk Assessment Framework process as shown in Annex B - Risk Assessment Framework.

7.5. Risk Analysis

The process of carrying out a risk assessment will result in an understanding of the level and significance of risks that leads to "Informed Decisions" related to the implementation of appropriate risk control and risk reduction measures.

Risk analysis is an analytical informative process to understand risk level that includes a detailed examination of the identified hazards, addressing the potential consequences and determining the severity level of addressed consequences, the likelihood of consequences occurrence and the risk level.

The unified Corporate Risk Matrix shall be used for carrying out qualitative and semi-quantitative risk assessments. The Corporate Risk Matrix is separated into four regions that identify the limit of risk tolerability:

1. **Level 1 - High Risk (Red / Intolerable Risk Region):** The risk level is not acceptable and risk control measures are required to move the risk figure to be tolerable and in the ALARP region.
2. **Level 2 - Risk reduction measure (Amber / Medium–High-Risk Region):** The risk level shall be mandatorily reduced applying suitable and sufficient corrective measures, provided that the implementation of such measures is ALARP.
3. **Level 3 - Risk reduction measure (Yellow / Medium-Risk Region):** The risk level requires control measures, provided that the implementation of such measures is ALARP.
4. **Continuous improvement (Green / Low-Risk Region):** The risk level requires continuous monitoring to prevent deterioration or deviation from performance standards.

Risk analysis may be undertaken using qualitative, semi quantitative or quantitative methods. Each of these methods is discussed briefly below.

7.5.1. Qualitative Risk Assessment

In the Qualitative Risk Assessment process, the risks are analysed based on expert judgment to judge the likelihood and impact of the hazardous events. The estimated severity and likelihood are plotted on the Risk Matrix to assign a level and category of the risk. Several techniques can be used in qualitative risk assessment, such as JSA, HAZID, HAZOP, etc.

The Corporate Risk Matrix includes the definitions of consequence severity and likelihood levels. If the estimated consequence severity varies for different categories, e.g., people, assets, etc. then the highest severity shall be selected for determining the overall risk level.

If the assessed risk level using qualitative methods (initial screening) is 'Red' or 'Amber', then Semi-Quantitative or Quantitative Risk Assessments shall be used to validate before deciding on risk treatment options. For the project phases, this is achieved by carrying out quantified studies for the identified Major Accident Hazards. Annex C - Qualitative Risk Assessment Workflow provides a more detailed overview.

7.5.2. Semi-Quantitative Risk Assessment

The basis for the risk estimate is usually qualitative, although increasingly there is some quantitative basis (for either the consequences or the likelihood or both).

Semi-quantitative risk assessments are structured risk assessment techniques, which can use simple consequence modelling techniques where applicable to derive estimates of the severity level of the hazard scenario and event trees and fault tree analysis to quantify the likelihood of hazards resulting in hazards events.

Estimating of failure frequencies and reliability data of specific equipment/systems are used to estimate the likelihood of unwanted events. These estimates can be combined with severity to obtain estimates of the order of magnitude of the risk.

Methods such as Layer of Protection Analysis (LOPA) shall be used for carrying out semi-quantitative risk assessments. This method may use techniques such as Fault Tree Analysis (FTA), Event Tree Analysis (ETA), ...etc., to quantify the frequencies.

7.5.3. Quantitative Risk Assessment

Quantified Risk Assessments involve a numerical estimate of the risk from a quantitative consideration of hazardous events probabilities (at which a release of the hazard may be expected to occur) and the size of consequences associated with a hazard. These aspects are then combined to obtain numerical values for risk, which is compared against the Holding Companies' Risk Tolerability Criteria to assure that overall risk levels are managed to As Low As Reasonably Practicable (ALARP).

Some risk assessment techniques may be used to estimate quantitatively different event rates/frequencies or probabilities (e.g., ETA), and for the quantitative determination of the size of the consequences usually consequence modelling software are used.

Detailed quantified assessment is usually carried out in various studies, such as QRA & FERA, each study has an objective and should cover a certain scope and purpose.

In carrying out quantitative risk assessments, specific quantitative tools and techniques are used for estimating the severity of the consequences and the likelihood of the hazardous scenario occurring for various identified scenarios within the study boundary. For details of the QRA process, refer to Quantitative Risk Assessment (QRA) Guideline EGPC-PSM-GL-008

7.6. Risk Evaluation

Risk evaluation refers to the process used to assist in making decisions based on the outcome risk analysis, by comparing the risk estimates with the risk tolerability criteria.

Risk evaluation is used to identify any residual risk (or increased risk level) and provides inputs to decisions making process on whether risks need to be treated and on the most appropriate risk treatment strategies and methods. Subsequently, the purpose of risk evaluation is to assist in making decisions (based on the outcomes of risk analysis) about which risks need treatment and which priority must be assigned for their treatment.

Risks are prioritized for risk response Unacceptable risks are ranked and prioritized with other risks. A common approach to prioritizing risks is to divide them into three bands (according to the unified Corporate Risk Matrix):

- An upper band, where the level of risk (Level 1 - Red) is regarded as intolerable whatever benefit the activity may bring, and risk treatment is essential whatever its costs;
- A middle band (Level 2 - Amber and Level 3 - Yellow), where costs and benefits are considered and opportunities balanced against potential consequences; and
- A lower band (Green), where the level of risk is regarded as negligible, or so small that no risk treatment measures are needed.

7.6.1. A framework for risk criteria

The most common framework used for risk criteria divides risks into the three bands shown in Figure 3:

- An unacceptable region, where risks are intolerable, and risk reduction measures are mandatory.
- A middle band, or tolerable if ALARP region, where risk reduction measures are desirable, but may not be implemented if their cost is disproportionate to the benefit achieved.
- A broadly acceptable region, where no further risk reduction measures are normally needed.

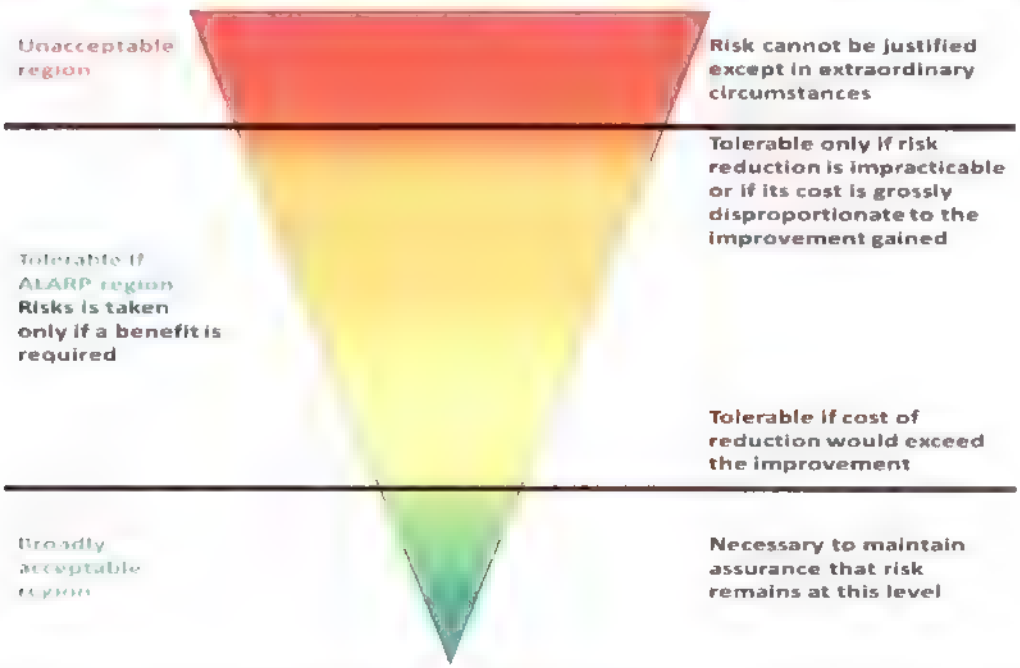


Figure 3: Framework for tolerability of risk (Ref. ALARP carrot diagram example given by UK HSE COMAH)

7.6.2. Criteria for Qualitative and Semi-Quantitative Risk Assessment

Risk criteria for qualitative and semi-quantitative risk assessment are defined in the risk matrix used for the assessment. A risk matrix facilitates the quick assignment of risk levels for each risk level (Red, Amber, Yellow and Green) demonstrated in the unified Corporate Risk Matrix.

As part of the Qualitative and Semi-Quantitative Risk assessment, once risks are identified:

- they are mapped on the risk matrix in four risk categories (Health & Safety, Environment, Financial and Non-Financial criteria), and
- short-term and long-term risk reduction measures are identified and against each of the recommendations, residual risk is determined and mapped on the risk matrix.

One of the key features of the risk matrix is accountability of the risk. Once the risk is mapped on the risk matrix, based on the risk level/category accountability is assigned across the management hierarchy for the risk reduction, action implementation, follow-up and closeout.

7.6.3. Quantitative Risk Assessment Tolerance Criteria

Quantitative risk criteria are standards used to translate numerical risk estimates, as produced by a Quantitative Risk Assessment (QRA), into value judgements such as 'negligible risk' (e.g. the risk value is lower than 10^{-6} which means lower than 1 fatality every 1 million years), that can then be set against other value judgements such as 'high economic benefit' in the decision-making process.

To define the three bands of risk (acceptable, Tolerable if ALARP, and unacceptable), two levels of risk criteria are required:

- A maximum tolerable criterion above which the risk is intolerable,
- A broadly acceptable criterion below which the risk is insignificant, and
- Between these two criteria, the ALARP region is laid

Risks to people may be expressed in two main forms:

- **Individual Risk** – the risk experienced by a person.
- **Societal (or Group) Risk** – the risk experienced by the whole group of people exposed to the hazard. Where the people exposed are members of the public, the term Societal Risk is often used. Where workers are isolated and members of the public are unlikely to be affected, the term group risk is often used. In this document, the term Societal Risk is used to encompass both public and worker risk.

7.6.3.1. Individual Risk Criteria (IRPA)

Individual Risk criteria are intended to show the frequency at which an individual (worker or public) may be expected to sustain a given level of harm from the realization of specified hazards. It is usually taken to be the risk of death and usually expressed as a risk per year.

Individual Risk is calculated by identifying all sources of fatality risk to a given individual, deriving the contribution from each source and then summing these to give the overall risk. For typical oil, gas and petrochemical workers the primary sources of risk as a minimum:

- Transport, e.g., road traffic accidents, air/sea transport accidents.
- Hydrocarbon related, e.g., loss of containment leading to toxic releases, fires or explosions.

Note: COMPANIES have the choice to consider the Occupational Safety Risks in their Quantitative Risk Assessment, e.g., slips, trips and falls, drowning, dropped objects, lifting, working at heights, etc. within the overall risk calculations (which might increase the overall risk value).

Individual Risk criteria are most expressed in the form of Individual Risk Per Annum (IRPA). The IRPA is a representative worker of a given worker group considering expected occupancy at all the locations he is expected to be present within the hazardous location throughout the year This includes plants, accommodations, recreational activities, etc. The calculation excludes the

duration for which personnel is not present at the site due to reasons such as annual leave, personnel is considered not exposed to facility operations or occupational risk during this duration. This criterion is applicable for all COMPANIES belonging to ENTITIES. It is mandatory to demonstrate that risk levels are within the criteria given in Figure 4.

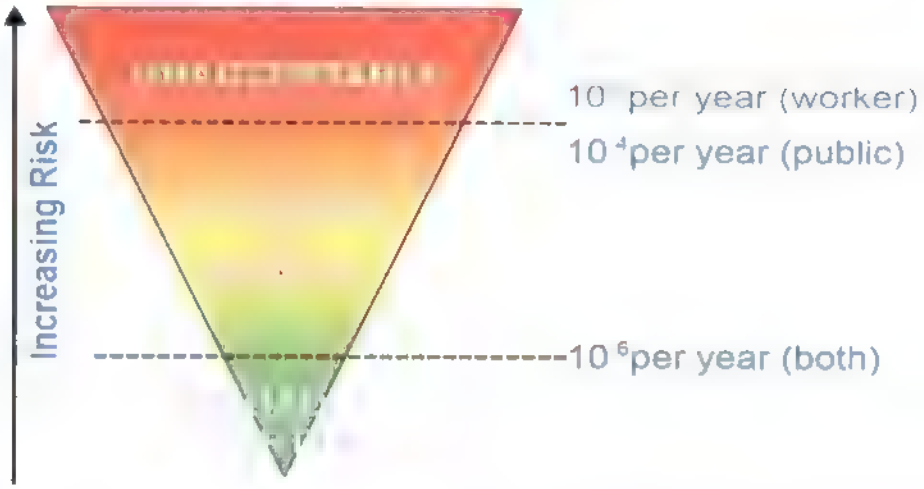


Figure 4: ALARP Demonstration (Ref UK-HSE - onshore process Individual Risk criteria)

	Workers	Member of public
Maximum tolerable criterion	10^{-3} per year	10^{-4} per year

Table 1: Tolerability Criteria

Note (1) Individual Risk Criteria are intended to demonstrate that individual people are not exposed to excessive risk, assuming all individuals are equally exposed and protected.
Note (2) Individual Risk to workers means Individual Risk to onsite personnel and outside nearby same business' industrial facilities only (i.e. petrochemical, oil and gas facilities), and Individual Risk to public means Individual Risk to offsite personnel.

At the top of the triangle is the unacceptable level, on or above which the risk is so great or the outcome so unacceptable that it must be reduced immediately.
At the other extreme is the broadly acceptable region, where the risk is so low that there is no further requirement to undertake additional risk reduction measures, i e , the risk is, or has been made, so small that no further precaution is warranted.
In between these two extremes, lies a wide range of tolerable risk levels to which the ALARP principle applies, i.e., the risk must be reduced to the lowest level practicable, bearing in mind the benefits flowing from its acceptance and taking account of the costs of any further reduction. Thus, for the risks, which fall within the Tolerable region, some weighing of costs and benefits i.e , Cost Benefit Analysis is necessary to determine compliance with the ALARP principle.

7.6.3.2. Societal (Group) Risk Criteria:

Societal Risk evaluation is concerned with the estimation of the chances of more than one individual being harmed simultaneously by an incident. The likelihood of the primary event (an accident at a major hazard plant) is still a factor, but the consequences are assessed in terms of the level of harm and the numbers affected (severity), to provide an idea of the scale of an accident in terms of numbers killed or harmed.

Societal Risk is dependent on the risks from the substances and processes located on a major hazard installation. A key factor in estimating Societal Risk is the population inside and around the site; in particular, its location and density.

The Criteria may be defined to limit the risk of major accidents and help target Societal Risk reduction measures (such as restrictions on concurrent activities or land use, enhanced engineered safeguards, and improved building siting or protection).

The concept of the Societal Risk against the Individual Risk is illustrated in the following

Figure 5. Where situations *I* and *II* have equal Individual Risk levels, while situation *II* has a larger Societal Risk (SR) because in situation *II* more people are exposed than in situation *I*. Therefore, if the Individual Risk levels are acceptable in both situations, the Societal Risk may not be acceptable for situation *II*.

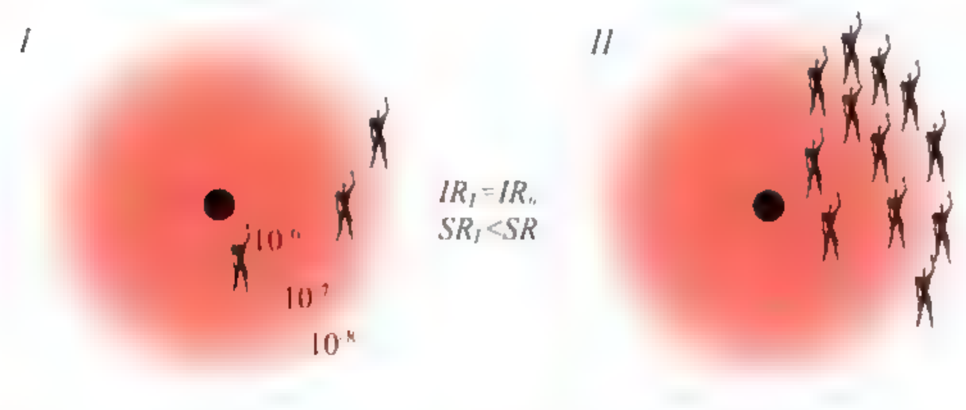


Figure 5 [illegible]
risks associated with high hazard facilities)

7.6.3.2.a. FN-diagram

The FN curve is the curve of cumulative frequency versus numbers of fatalities on a logarithmic scale. FN curves are frequency-fatality plots, showing the cumulative frequencies (F) of events involving N or more fatalities. They are derived by sorting the frequency-fatality (FN) pairs from each outcome of each accidental event and summing them to form cumulative frequency-fatality (FN) coordinates for the plot.

A common form of presenting risk tolerability Criteria for Societal Risk on an FN diagram is to have two criteria lines to distinguish three regions; an area where risk is intolerable, an area where it is broadly acceptable and a region where it requires further assessment and risk reduction as far as is reasonably practicable. ENTITIES' Criteria for Societal Risk is shown in Figure 6.

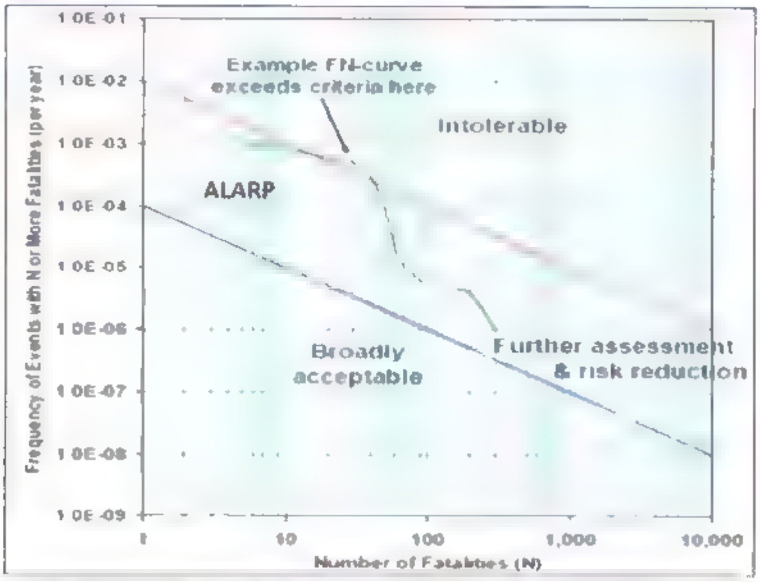


Figure [illegible] Societal Risk [illegible] quantitative assessment of risks associated with high hazard facilities, with adaptation)

At the top of the curve is the unacceptable level (F = 2.0E-04, for N = 50, and the Slope = -1), on or above which the risk is so great or the outcome so unacceptable that it must be reduced immediately.

At the other extreme is the broadly acceptable level (F = 2.0E-06, for N = 50, and the Slope = -1), where the risk is so low that there is no further requirement to undertake additional risk reduction measures, i.e., the risk is, or has been made, so small that no further precaution is warranted.

In between these two extremes, lies a wide range of tolerable risk levels to which the ALARP principle applies, i.e., the risk must be reduced to the lowest level practicable, bearing in mind the benefits flowing from its acceptance and taking account of the costs of any further reduction.

7.6.3.2.b. Potential Loss of Life (PLL)

The other main measure for Societal Risk is the annual fatality rate, where the frequency and number of fatalities are combined into a Potential Loss of Life (PLL), which is a convenient one-dimensional measure of the total number of expected fatalities.

Potential Loss of Life (PLL) is simply the sum of the products of all f-N pairs, (i.e., Potential Loss of Life = ΣFN [people/year])

PLL is well suited for comparing alternative solutions for the same facility is relatively easy to understand for non-risk specialists and must be calculated to be able to derive the cost-effectiveness of risk reduction options (Multiplying the annual PLL by the expected lifetime of a facility gives a Lifetime PLL by which the overall number of fatalities incurred by the facility, over its entire operational period, can be estimated), lifetime PLL is how risk reduction measures should be assessed by using Cost Benefit Analysis. PLL should be presented as a measure to compare the relative degree of "safety", expressed as potential loss of life for different options or developments. This should be used in conjunction with IRPA levels.

7.6.3.3. Risk contours (LSIR) criteria for Land Use Planning (LUP)

Risk contours are iso-risk contours plot represent the geographical variation of the risk for a hypothetical individual who is positioned at a particular location for 24 hours per day, 365 days per year. This is also known as Location-Specific Individual Risk (LSIR).

Land use planning (LUP) criteria is a planning tool to advise on new developments, accommodations that are constructed near the existing facility boundary or for siting the facility in the vicinity of the existing occupied building area or master plan updates for existing assets. The purpose of defining LUP zones is to minimize risk to people around the hazardous facility by specifying how close certain types of facilities can be developed. For example, relatively low occupancy nonindustrial development such as warehouses...etc. can be allowed to be relatively close to the facility boundary whereas vulnerable populations, such as schools, hospitals ...etc. need to be further away from the facility.

The recommended Individual Risk levels to be used, in respect to hazardous substances/sites, are including the risk contributions from all sources with the inner zone criteria of LSIR from 10^{-4} to 10^{-5}, middle zone 10^{-5} to 10^{-6} and outer zone beyond 10^{-6} per year. Restrictions are placed on activities or structures within the various zones, as shown in the following Figure 7.

Figure 7 Allowable Land Uses

(Ref. Major Industrial Accidents Council of Canada –MIACC's Risk Acceptability Criteria)

Zones	Examples for types of Allowable Land Uses	Location Specific Individual Risk (LSIR)
Zone 0	Process plant/utilities/ industrial facilities are permitted etc.	1E-4
Zone 1	Manufacturing, warehouse, parkland, open space, etc.	1E-4 – 1E-5
Zone 2	Commercial offices and law densities residential	1E-5 – 1E-6
Zone 3	All other uses including institutions, high densities residential etc.	< 1E-6

Table 2: Definition of Zones for Land Use Planning (LUP)

Note 1, The LUP Above criteria shall be used in conjunction with the F N curve, H_2S zones and consequence-based approach for toxic hazards as applicable.

Note 2, The LUP criteria shall be applied for new oil and gas facilities to be selected at safe distances as much as possible from areas with a different designation, whereas operating facilities and old facilities may be subjected to encroachments and outside activities, unfortunately, the responsible law for preventing such encroachments does not support the LUP criteria.

7.7. Risk Treatment

After assigning priority to risks, risk treatment should be identified to determine suitable responses, so that the remaining risk falls within the acceptable level of exposure.

Risk treatment should comply with legal requirements, as well as government and organizational policies. Therefore, decisions concerning whether risk treatment is required may be based on operational, technical, financial, legal, social, environmental or other criteria. Such criteria should reflect the organization's context, and depend on its internal policies, goals and objectives, as well as its stakeholders' needs. In this respect, a team approach is useful to help define the context properly and for well-targeted change management during risk treatment.

Approaches for risk treatment strategies are detailed in Annex E - Risk Control Measures.

8. Reporting Risks

For a new project, all risk assessment and associated risk reduction measures are usually documented in the respective HSE and Process Safety studies, ALARP demonstration report and Safety Case report. The Project Manager is the accountable and is responsible for the implementation of the risk reduction measures. The Risk Register and Action Plan (RRAP) (see Annex D - Risk Register and Action Plan Template) shall be used to record, track, closeout and follow up for all the identified risks.

For operating sites, where risks are identified, risk assessments reports are developed. All the identified short term and long-term risk reduction measures shall be documented and tracked via the RRAP. For all the identified risk levels and risk reduction measures, based on the identified risk levels, the risk accountable shall be assigned for the implementation of the risk reduction measures. Management approval of the identified risk and its risk reduction measure shall be obtained as per the Corporate Risk Matrix. Risk is not considered to be mitigated unless all the risk reduction measures are implemented.

From the risk assessment process, each COMPANY shall develop a Risk Register which details the main areas of risk associated with activities in all operating units (e.g., exploration, development, projects, operations), including normal and temporary activities (e.g., operation plant, warehouse, marine base, headquarter, drilling activity, seismic).

The RRAP shall capture the most significant hazards (together with their consequences and probability of occurrence) which, if realized, have the potential to adversely affect the COMPANY with consequential negative impacts on its HSE performance and reputation. Those risks are typically screened as Level 1 (Red), Level 2 (Amber) and Level 3 (Yellow).

The RRAP is owned by COMPANIES' managing director(s) while the custodian is the Risk Champion of relevant risk level. The RRAP is a live document and it shall be reviewed and updated frequently as identified in Annex H - Risk Management Review Committees.

9. Risk Communication

It is required that certain risk-related information be communicated to the workforce. There are three reasons why this is necessary:

a. Members of the workforce are exposed to risk in their daily work lives.
b Some members of the workforce have key roles to play in the risk management process relating to the management of risk reduction measures (barriers).
c In their day-to-day activities, members of the workforce might interact with barriers (e g., via maintenance processes which if performed incorrectly can defeat barriers).

All members of the workforce need an understanding of:

a. What existing risks are they exposed to?

b. How they are managed.
c. Role of individuals in managing and maintaining barriers.
d. Role of risk management measures.

Not everyone needs the same level of understanding and information. Communication can be tailored as appropriate to other key stakeholders. Information that is shared can include:

a. Key facility-level risks.
b. Barriers to managing these risks (i.e., what, why and how they work).
c. Risk management plans including corrective actions relating to barrier deficiencies (and risk reduction opportunities).
d. Roles and responsibilities of individuals in managing and maintaining barriers.
e. Risk process and what to do if they find barrier degradation.
f. What actions they may be required to take in an emergency

Level 1 (Red) risks shall be communicated to relevant ENTITY as part of the planning cycle to allow strategic management of risks and to prioritize resource allocation at the appropriate level.

Annex H - Risk Management Review Committees provides a high-level structure for the Risk Management committees at a different level of risks where the risk shall be communicated.

9.1. Signoff Authority

The consultation and communication shall be through the Risk Register and action tracking process. The consultation process is carried out as part of risk assessment workshops with relevant stakeholders, wherein, all the identified risks from semi-quantitative studies and quantified studies, are captured, monitored and reported to the appropriate signoff authority and Executive Leadership Team. Reporting requirements, actions required and signoff authority levels for various risk levels are given in Annex G - Roles and Responsibilities.

10. Monitor/Review the Risks

All the identified risk and associated risk reduction measures once recorded in the risk register shall be reviewed periodically by associated stakeholders. A typical periodical review scheme is detailed in Annex H - Risk Management Review Committees.

Each ENTITY is to conduct a Risk Review Meeting to discuss Level 1 risks received from their COMPANIES.

Risk Management Steering Committee shall convene periodically to discuss the Level 1 risks escalated from relevant ENTITIES.

The review should involve the following activities:

- Periodic review of identified risk levels/categories, which are not yet mitigated, or in process of mitigation to confirm the assumptions made during risk assessment is still valid and identified controls are functioning as intended. These activities should be carried out by the site team;
- Monitoring status of identified risk reduction measures to confirm the plan to manage and mitigate the risk is progressing. Where alternate options are identified during the review, the risk assessment shall be updated accordingly; and,
- Monitoring status of existing controls and any short-term actions in place until permanent mitigation measures are implemented.

11. Compliance Assurance

ENTITIES shall conduct a compliance audit of this Standard at approximately three-year intervals; these audits will be in addition to COMPANIES' HSE internal audits.

The main audit deliverable is a formal and structured report for the attention of the Risk Management Steering Committee.

12. Performance KPIs

Key Performance Indicators (KPIs) for this Standard will be considered in the Process Safety Key Performance Indicators (KPIs) Guideline EGPC-PSM-GL-025.

13. Deviation

Deviation from any requirement of this Standard shall be approved in writing by the CEO of the relevant ENTITY, with the consultation of the relevant CEO Assistant for HSE.

Each COMPANY belonging to any of the ENTITIES follows a risk assessment matrix different from the unified Corporate Risk Matrix, shall either move to the unified Corporate Risk Matrix or correlate their risk assessment matrix with the unified Corporate Risk Matrix. The correlation of the risk matrix is considered as a deviation.

A written dispensation includes a rationale and detailed description of the alternative robust process that will be conducted.

Approved dispensation shall not apply indefinitely and shall be are reviewed annually by the relevant CEO Assistant for HSE.

14. References

[1] EGPC, "Operating Manual System (OMS) Framework," Egyptian General Petroleum Corporation, Cairo, 2020.

[2] EGPC, "Operating Manual System (OMS) Implementation Guideline EGPC-GEN-GL-010," Egyptian General Petroleum Corporation, Cairo, 2020.

[3] ISO, "Risk management – Guidelines ISO 31000 2018," International Organization for Standardization, Geneva, 2018 .

[4] ISO, "Risk management – Risk assessment techniques ISO 31010 2019," International Organization for Standardization, Geneva, 2019.

[5] IOGP IPIECA, "Operating Management System Framework for controlling risk and delivering high performance in the oil and gas industry, Report 510," The International Association of Oil & Gas Producers, London, 2014.

[6] IOGP IPIECA, "OMS in practice - A supplement to Report No. 510, Report 511," The International Association of Oil & Gas Producers, London, 2014.

[7] HSL U K, "Good Practice and Pitfalls in Risk Assessment, Research report 151," Health & Safety Executive, London, 2003.

[8] U KOOA, "Industry Guidelines on a Framework for Risk Related Decision," U K Offshore Operators Association, London, 1999

[9] HSE U K, "Societal Risk. Initial briefing to Societal Risk Technical Advisory Group, Research report 703," Health & Safety Executive, London, 2009.

[10] CCPS, "Guidelines for - Developing Quantitative Safety Risk Criteria,' Centre for Chemical Process Safety, New York, 2009.

[11] CSChE, "Risk Assessment – Recommended Practices," Canadian Society for Chemical Engineering, Ottawa, 2004.

[12] DNV, "Criteria and Risk-Based Damage Stability Final Report -0165, Part I Risk Acceptance Criteria," DNV, 2015.

[13] Risktec-TUV, "Risk-Based Decision Making and ALARP - An introduction to making risk-based decisions and reducing risks As Low As Reasonably Practicable (ALARP).," TUV, 2018

[14] Risktec-TUV, "Quantitative Risk Assessment (QRA) - An introduction to the quantitative assessment of risks associated with high hazard facilities," TUV, 2018.

15. List of Annexes

- Annex A - Corporate Risk Assessment Matrix
- Annex B - Risk Assessment Framework
- Annex C - Qualitative Risk Assessment Workflow
- Annex D - Risk Register and Action Plan Template
- Annex E - Risk Control Measures
- Annex F - Risk Assessment Fundamentals
- Annex G - Roles and Responsibilities
- Annex H - Risk Management Review
- Annex I - Signoff requirements for various residual risk levels

Annex A - Corporate Risk Assessment Matrix

CORPORATE RISK MATRIX

Term	Rare	Unlikely	Possible	Likely	Very Likely	Almost Certain
Frequency	≥ 10^{-6} to < 10^{-5}	≥ 10^{-5} to < 10^{-4}	≥ 10^{-4} to < 10^{-3}	≥ 10^{-3} to < 10^{-2}	≥ 10^{-2} to < 10^{-1}	≥ 10^{-1} to ≤ 1
Probability	< 0.001%	> 0.001% < 0.01%	> 0.01% 0.1%	> 0.1% 1%	> 1% 10%	> 10% 100%
Likelihood	A similar event has not yet occurred somewhere in our industry	A similar event has occurred somewhere in our industry but not in ENTITIES	A similar event has occurred at least Once in ENTITIES	Event has occurred at least once in ENTITIES or is likely to occur within the lifetime of 10 similar COMPANIES	Event has occurred more than several times in ENTITIES or has occurred once or twice in the lifetime of the COMPANY	The event likely to occur several times in the lifetime of the COMPANY

Severity	HSE Impact		Business Impact		#						
	Health and Safety	Environmental	Financial	Non-Financial		1	2	3	4	5	6
			Financial Impact on Asset, Projects and Production	Reputation, Media, Key Stakeholder Reaction and Regulatory Enforcement							
Disastrous	• Potential for multiple fatalities Onsite / or onset of life threatening Health effects) • > 10 injuries or health effects, either permanent or requiring hospital treatment for more than 24 hours • Single or more than 1 Public Fatality	• Future impact, e.g. uncontrolled release with widespread damage which remains in an "unsatisfactory" state for a period > 5 years • Discharge of contaminants > 100,000L in offshore and/or > 10,000L in sensitive areas	• Disastrous damage • Revamping necessary to resume the operations/business > 50% of Annual Production/Business/Profit Plan)	• International Concern • Extensive negative attention in mainstream media • Long term national damage • Substantial long term damage to relationships with key stakeholders • Action by a government resulting in a complete and permanent loss of licenses to operate • Potentially never regain access to new areas	A	1A	2A				
Catastrophic	• Potential single fatality Onsite, onsite or chronic, actual or alleged. • 10 or more injuries or health effects, either permanent or requiring hospital treatment for more than 24 hours. • Serious injury to public	• Future impact with extensive damage which can only be restored to a "satisfactory"/agreed state in a period of more than 1 and up to 5 years • Discharge of contaminants 1,000 10,000L to sensitive areas and/or 10,000 100,000L in offshore	• Extensive damage • Major change to resume operations / business (> 35% 50% of Annual Production/Business/Profit Plan)	• Nationwide public attention • National & global media coverage • Medium term national damage • Moderate long term Damage to relationships with key stakeholders • Action by a government resulting in partial and/or temporary loss of license to operate • Substantial regulatory enforcement action by regulator	B	1B	2B	3B			
Major	• Permanent disability (ies) • 3 or more injuries or health effects, either permanent or requiring hospital treatment for more than 24 hours.	• Future impact with extensive damage which can be restored to an equivalent capability in a period of around 1 year • Discharge of contaminants 100 1,000L to sensitive areas and/or 1,000 to 10,000L in offshore	• Major damage • Long time change to resume operations / business (> 20% 35% of Annual Production/Business/Profit Plan)	• National public concern • Extensive negative attention in national media • Long term loss damage • Partial Damage to relationships with key stakeholders • Moderate regulatory enforcement action by regulator • Potentially restrictive measures and/or impact on grant of licenses	C		2C	3C	4C		
Serious	• Lost Time Injury (LTI) • Partial disability (ies) • Several non-permanent injuries or health impacts	• Future impact with localized damage which can be restored to an equivalent capability in a period of months. • Discharge of contaminants 10 100L to sensitive areas and/or 100 to 1,000L in offshore	• Local damage • The unit has been repaired/replaced to resume operations/business (< 5% 15% of Annual Production/Business/Profit Plan)	• Regional public concern • Negative attention national media • Limited local damage • Limited Damage to relationships with local stakeholders • Limited regulatory enforcement action by regulators • Possibly negative stance of local government	D			3D	4D	5D	6D
Minor	• Recordable injury or health effects (non-permanent injury / ailment) • Medical Treatment Case or Restricted Work Day Case	• Future impact with immediate area damage which can be restored to an equivalent capability in a period of months. • Discharge of contaminants < 10L to sensitive areas and/or 100 10L in offshore	• Minor damage • Possible short disruption of operations / business (> 1% 5% of Annual Production / Business / Profit Plan)	• Some local public concern / media coverage • Limited damage to relationships with local stakeholders • Government reaction to non-compliance with legal and regulatory requirements that does not result in consequences beyond simply restoring regulatory compliance	E				4E	5E	6E
Notable	• First aid • Overexposures causing noticeable irritation but no actual health effects	• Future impact with immediate area damage which can be restored to an equivalent capability in a period of days or weeks. • Discharge of contaminants which do impact to sensitive areas and/or < 10L in offshore	• Slight damage • Disruption to operations / business (< 0.1% of Annual Production / Business / Profit Plan)	• No public concern / media coverage • Negligible damage to relationships with local stakeholders • Non-compliance with regulatory requirement that does not generate any government reaction	F					5F	6F

Risk Level	Minimum Required Action	Management Signoff Authority
	Long term operation in high risk not allowed. Immediately identify risk mitigation according to the hierarchy of controls and implement risk mitigation to reduce the risk to ALARP within 30 days. In case of non-action, an approval from relevant holding company shall be obtained. Include in Risk Register for tracking. Consider advanced Risk Analysis methodologies for further investigation. Reporting within 24hrs. Notify relevant Oil & Gas Holding Companies within 7 Days.	Signoff by Chairman / Managing Director(s) / VP's/CEO Consultation with appropriate SME required)
Level 2 Medium/High (Tolerable if ALARP)	Conduct an ALARP study to determine if the cost of implementing additional risk mitigation is appropriate. Include in Risk Register for tracking. Consider advanced Risk Analysis methodologies for further investigation. Reporting time within 7 Days	Signoff by Senior management e.g. Operations GM, Projects GM Drilling GM Financial GM, HSE GM ..etc
Level 3 Medium Tolerable if ALARP)	Conduct an ALARP study to determine if the cost of implementing additional risk mitigation is appropriate. Monitor and improve effectiveness of current controls. Include in Risk Register for tracking. Reporting time within 30 Days	Signoff by Function GM e.g. District GM, Refinery Unit GM etc
	Low Priority. Monitor and improve effectiveness of current controls. Include in Risk Register for tracking.	Signoff by Area Authority e.g. OIM, Production Manager, Maintenance Manager ..etc

Table 3 HSE Impact Levels

Severity Level		Health and Safety	Environmental
Disastrous	A	• Potential for multiple fatalities Onsite (or onset of life-threatening Health effects) • > 10 injuries or health effects, either permanent or requiring hospital treatment for more than 24 hours • Single or more than 1 Public Fatality	• Future impact, e.g., unintended release, with widespread damage which remains in an "unsatisfactory" state for a period > 5 years. • Discharge of contaminants > 100,000L in offshore and/or > 10,000L in sensitive areas
Catastrophic	B	• Potential single fatality Onsite, acute or chronic, actual or alleged. • 10 or more injuries or health effects, either permanent or requiring hospital treatment for more than 24 hours. • Serious injury to the public	• Future impact with extensive damage which can only be restored to a "satisfactory"/agreed state in a period of more than 1 and up to 5 years. • Discharge of contaminants 1,000 - 10,000L to sensitive areas and/or 10,000 - 100,000L in offshore
Major	C	• Permanent disability(ies) • 3 or more injuries or health effects, either permanent or requiring hospital treatment for more than 24 hours.	• Future impact with extensive damage which can be restored to an equivalent capability in a period of around 1 year. • Discharge of contaminants 100 - 1,000L to sensitive areas and/or 1,000 to 10,000L in offshore
Serious	D	• Lost Time Injury • Partial disability(ies) • Several non-permanent injuries or health impacts	• Future impact with localized damage which can be restored to an equivalent capability in a period of months. • Discharge of contaminants 10 - 100L to sensitive areas and/or 100 to 1,000L in offshore
Minor	E	• Recordable injury or health effects from common source/event. • Medical Treatment Case or Restricted Work Day Case	• Future impact with immediate area damage which can be restored to an equivalent capability in a period of months. • Discharge of contaminants < 10L to sensitive areas and/or 100 - 10L in offshore
Notable	F	• First aid • Over-exposures causing noticeable irritation but no actual health effects	• Future impact with immediate area damage which can be restored to an equivalent capability in a period of days or weeks. • Discharge of contaminants with no impact to sensitive areas and/or < 10L in offshore

Table 4: Business Impact Levels

Severity Level		Financial	Non-Financial
		Financial Impact on Asset, Projects and Production	**Reputation, Media, Key Stakeholder Reaction and Regulatory Enforcement**
Disastrous	**A**	• Disastrous damage • Revamping necessary to resume the operations/business (> 50% of Annual Production/Business/Profit Plan)	• International concern • Extensive negative attention in international media • Long term national outrage • Substantial Long-term damage to relationships with key stakeholders • Action by a government resulting in a complete and permanent loss of license to operate • Potentially severe impact on access to new areas
Catastrophic	**B**	• Extensive damage • Major change to resume operations / business (> 35% - 50% of Annual Production/Business/Profit Plan)	• International public attention • National & global media coverage • Medium-term national outrage • Moderate long term Damage to relationships with key stakeholders • Action by a government resulting in partial and/or temporary loss of license to operate • Substantial regulatory enforcement action by regulators
Major	**C**	• Major damage • Long time change to resume operations / business (> 20% - 35% of Annual Production/Business/Profit Plan)	• National public concern • Extensive negative attention in national media • Long term local outrage • Partial Damage to relationships with key stakeholders • Moderate regulatory enforcement action by regulators • Potentially restrictive measures and/or impact on grant of licences
Serious	**D**	• Local damage • The unit has been repaired/replaced to resume operations/business (> 5% 1% of Annual Production/Business/Profit Plan)	• Regional public concern • Negative attention national media • Limited local outrage • Limited Damage to relationships with local stakeholders • Limited regulatory enforcement action by regulators. • Possibly negative stance of local government
Minor	**E**	• Minor damage • Possible short disruption of operations / business (> 1% - 0.1% of Annual Production / Business / Profit Plan)	• Some local public concern/media coverage • Limited damage to relationships with local stakeholders • Government reaction to non-compliance with legal and regulatory requirements that do not result in consequences beyond simply restoring regulatory compliance
Notable	**F**	• Slight damage • Disruption to operations / business (< 0.1% of Annual Production / Business / Profit Plan)	• No public concern/media coverage • Negligible damage to relationships with local stakeholders • Non-compliance with regulatory requirements that do not generate any government reaction

Table 5: Likelihood Levels

Likelihood of Risk Event					
Rare	**Unlikely**	**Possible**	**Likely**	**Very Likely**	**Almost Certain**
1	**2**	**3**	**4**	**5**	**6**
Qualitative criteria					
A similar event has not yet occurred somewhere in our industry	A similar event has occurred somewhere in our industry but not in ENTITIES	A similar event has occurred at least Once in ENTITIES	Event has occurred at least once in ENTITIES or is likely to occur within the lifetime of 10 similar COMPANIES	Event has occurred more than several times in ENTITIES or has occurred once or twice in the lifetime of the COMPANY	The event is likely to occur several times in the lifetime of the COMPANY
Quantitative criteria - Frequency (Occurrence/year)					
$\geq 10^{-6}$ to $<10^{-5}$	$\geq 10^{-5}$ to $<10^{-4}$	$\geq 10^{-4}$ to $<10^{-3}$	$\geq 10^{-3}$ to $<10^{-2}$	$\geq 10^{-2}$ to $<10^{-1}$	$\geq 10^{-1}$ to ≤ 1
Alternatively expressed as;					
Greater than 1 in a million	Greater than 1 in 100,000	Greater than 1 in 10,000	Greater than 1 in 1,000	Greater than 1 in 100	Greater than 1 in 10

Where data exists to provide a quantitative estimate of likelihood, the use of the frequency and probability criteria is preferred. If not, the qualitative criteria can be used.

Risk Assessment Matrix

	Likelihood	Rare	Unlikely	Possible	Likely	Very Likely	Almost Certain
Severity	#	1	2	3	4	5	6
Disastrous	A	1A	2A	[illegible]	[illegible]	[illegible]	[illegible]
Catastrophic	B	1B	2B	3B	[illegible]	[illegible]	[illegible]
Major	C	[illegible]	2C	3C	4C	[illegible]	[illegible]
Serious	D	[illegible]	[illegible]	3D	4D	5D	6D
Minor	E	[illegible]	[illegible]	[illegible]	4E	5E	6E
Notable	F	[illegible]	[illegible]	[illegible]	[illegible]	5F	6F

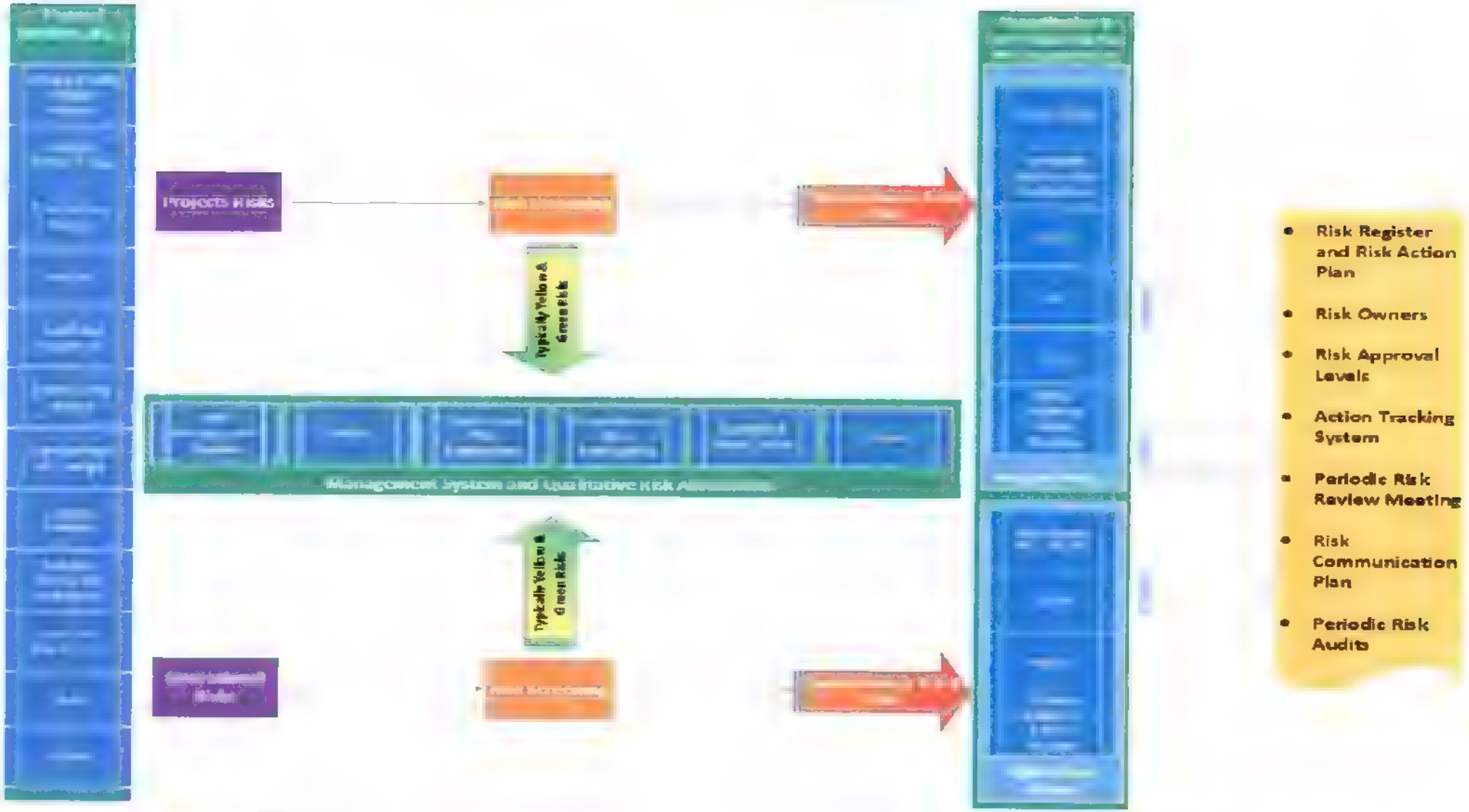
Plotting on a single risk matrix provides a visual representation of the assessment of risk

While risk assessment supports the prioritisation of risk management measures and resources, the position risk is plotted on the matrix is not to be interpreted as prioritising the allocation of resources for the management of one risk over another. Each risk is different, has specific consequences, and requires the appropriate consideration of risk management measures.

Risk assessment involves a range of methodologies and qualitative judgments and is, by its nature, inexact. It often relies on historic data, which may not accurately predict the true likelihood of a future scenario. Risks are typically represented by hypothetical scenarios that may not have ever occurred.

When positioning a risk event on the risk matrix, it is not usually possible to determine precisely the impact and likelihood of the risk event. The position on the risk matrix reflects this uncertainty and is only approximate.

Annex B - Risk Assessment Framework



Annex C - Qualitative Risk Assessment Workflow

Annex D - Risk Register and Action Plan Template

Risk Register and Action Plan (RRAP) Worksheet

Company		Holding Company		Risk Assessment	HSE Risk				Business Risk			
Site / Facility		Unit			Initial (Worst Credible)	Current (Net)	Short Term Residual Risk	Long Term Residual Risk	Initial (Worst Credible)	Current (Net)	Short Term Residual Risk	Long-Term Residual Risk
System		Equipment		Probability of Risk Event								
Function / Department		Location		Impact / Severity Level								
Risk ID		Risk Title		Risk Rating								
Risk Type				Comments								
Risk Status												
Risk Response Strategy				Current Risk Level								
Identification Date		Date of last Update			Action Status							
Risk Champion		Risk Accountable			Draft	Completed	Enduring	Not Started Yet	In progress	Overdue	Deleted	Total
					0		0		0		0	0

Risk Description

Hazard and Cause / Threat	Risk Event / Hazardous Scenario	Consequence(s)			
		Health / Safety	Environment	Financial	Non-Financial Reputation / Regulatory Enforcement

Action ID	Controls or Safeguards or Barriers (Prevention / Mitigation)	Control Measure Type	Action Owner	Action Issuance Date	Action Original Planned Target Date	Action Actual Closeout date	Action last Update Date	Status	Priority	Barrier Type	Barrier Category

Risk Assessment Team			Residual Risk Endorsement & Approval				
Name	Position	Signature	Residual Risk (Current - Net)	Required Approval	Name	Signature	Date
			High / Medium / Medium				

Annex E - Risk Control Measures

In common with governments and societies, companies recognise it is not always possible to eliminate or avoid risk entirely, but they are expected to take reasonable measures to reduce and/or mitigate risk to a level deemed acceptable.

To enjoy the benefits of road transport, for example, people generally accept a level of risk while expecting governments to improve measures to reduce accidents and pollution. Likewise, when a COMPANY is establishing controls to manage operating risk, acceptance judgements and decisions regarding any "residual risk" will need to be made at a level in the organisation commensurate with the risk. To ensure consistency, risk management is commonly supported by criteria and approval processes.

There are different response action categories, which correspond to key general approaches for risk treatment. These response action categories are:

1. **Tolerate**, in case the level of risk is below the Risk Appetite.
2. **Treat**, aiming at constraining risks to an acceptable level by removing the risk source and/or reducing likelihood or effects.
3. **Terminate**, in case the risk is only treatable, or reducible to acceptable levels, by terminating the activity, especially at a project level.
4. **Transfer**, reducing the exposure of the organization leaving the risk to another organization considered more capable of effectively managing such risks.
5. **Take the opportunity**, which is not an alternative whenever tolerating, transferring or treating a risk.

1. *TOLERATE*

The exposure may be tolerable without any further action being taken or even if not tolerable, the ability to do anything may be limited (or the cost of taking any action may be disproportionate to the potential benefit). In these cases, the response may be to tolerate the existing level of risk. This option, of course, may be supplemented by contingency planning for handling the impact that will arise if the risk results in actual events. The actions related to this kind of approach are:

- **Risk acceptance:** no action is taken to affect likelihood or impact.
- **Retaining:** after risks have been changed or shared, there will be residual risks that are retained. The risk can be retained by informed decision: acceptance of the burden of loss, or benefit of gain, from a particular risk, including the acceptance of risks that have not been identified. Risks can also be retained by default, e.g., when there is a failure to identify or appropriately share or otherwise treat risks. Moreover, after opportunities have been changed or shared, there may be residual opportunities that are retained without any specific immediate action being required (retaining the residual opportunity).

2. *TREAT*

Usually, the majority of risks are addressed this way. The purpose of treatment is that whilst continuing with the activity that gives rise to the risk, specific action is taken to constrain a risk to an acceptable level. Generally, Actions related to Risk Treat depend on two approaches:

- **Removing:** removing the risk source.
- **Risk reduction**, actions are taken for:
  - **Changing likelihood** (mitigating actions): action taken to reduce the likelihood of negative outcomes and/or to increase opportunity, to get good outcomes.
  - **Changing the consequences** (contingency actions): actions taken to reduce the extent of losses and/or to increase the extent of gains regarding related opportunities. These include setting up pre-event measures and post-event responses such as continuity plans.

Risk reduction measures include preventative or control measures (likelihood reducing) and mitigation or recovery measures (consequence severity reducing). If the risk is Green, no action may be required.

Yellow, Amber and Red risks require formulating a remedial action plan, which should include agreed actions, responsible person(s), and completion date(s). In formulating these plans, it is important to realize that risk management measures include organizational and system measures, such as:

- Personnel training and qualification procedures;
- Change control and documentation procedures;
- Quality assurance, operation, maintenance and inspection procedures; and,
- Follow up that includes regular updates for progress to ensure actions are closed as per the remedial plan.

From the risk management perspective, the first kind of action (changing likelihood) should be preferred as it prevents the risk rather than waiting for the consequences.

Note. Risk treatment options are not necessarily mutually exclusive, or appropriate in all circumstances. Often a risk response may combine two or more of these strategies to achieve the desired results. An organization can normally benefit from adopting a combination of treatment options. Implementation of the risk responses selected involves developing a risk plan, outlining the management processes that will be used to manage risk or opportunity to a level set up by the organization's 'risk appetite' and culture. Risk treatment involves selecting one or more options for modifying risks and implementing those options. Once implemented, treatments provide or modify controls: any action taken to address a risk forms part of what is known as "internal control".

3. *TERMINATE*

Some risks will only be treatable, or reducible to acceptable levels, by terminating the activity. It can be particularly important in project management.

- **Avoiding:** action is taken to stop the activities giving rise to risk or avoiding the risk by not starting such activities (where this option can be practised) Risk avoidance cannot occur properly if individuals or organizations are unnecessarily risk-averse. Inappropriate risk avoidance may either increase the significance of other risks or lead to the loss of opportunities

4. *TRANSFER*

For some risks, the best response may be to transfer them. The transfer of risks may be considered to either reduce the exposure of the organization or because another organization is judged more capable of effectively managing such risks. It is worth noting that some risks are not (fully) transferable: in particular, reputational risk can hardly be transferred. A relationship with the third party to which the risk is transferred needs to be carefully managed to ensure a successful transfer. Actions related to this kind of approach are as follows:

- **Transferring** the risk or a portion of it.
- **Sharing**: another party or parties bearing or sharing some part of the risk outcomes, usually by providing additional capabilities or resources that increase the likelihood of opportunities, or the extent of gains from them. Sharing positive outcomes can involve sharing some of the costs involved in acquiring them. Sharing arrangements can often introduce new risks, in that the other party or parties may not effectively deliver the required capabilities or resources.

5. *TAKE THE OPPORTUNITY*

This option is not an alternative to those above; rather it is an option that should be considered whenever tolerating, transferring or treating a risk.

This can occur in two ways:

- The first is when an opportunity arises to exploit positive impact whether action is taken to mitigate threats at the same time.

- The second is when circumstances arise which, whilst not generating threats, offer positive opportunities.

Hierarchy of Controls

As a general recommended strategy for risk control, *Figure 8* illustrates the Hierarchy of Controls for risk reduction in terms of their comparative effectiveness.

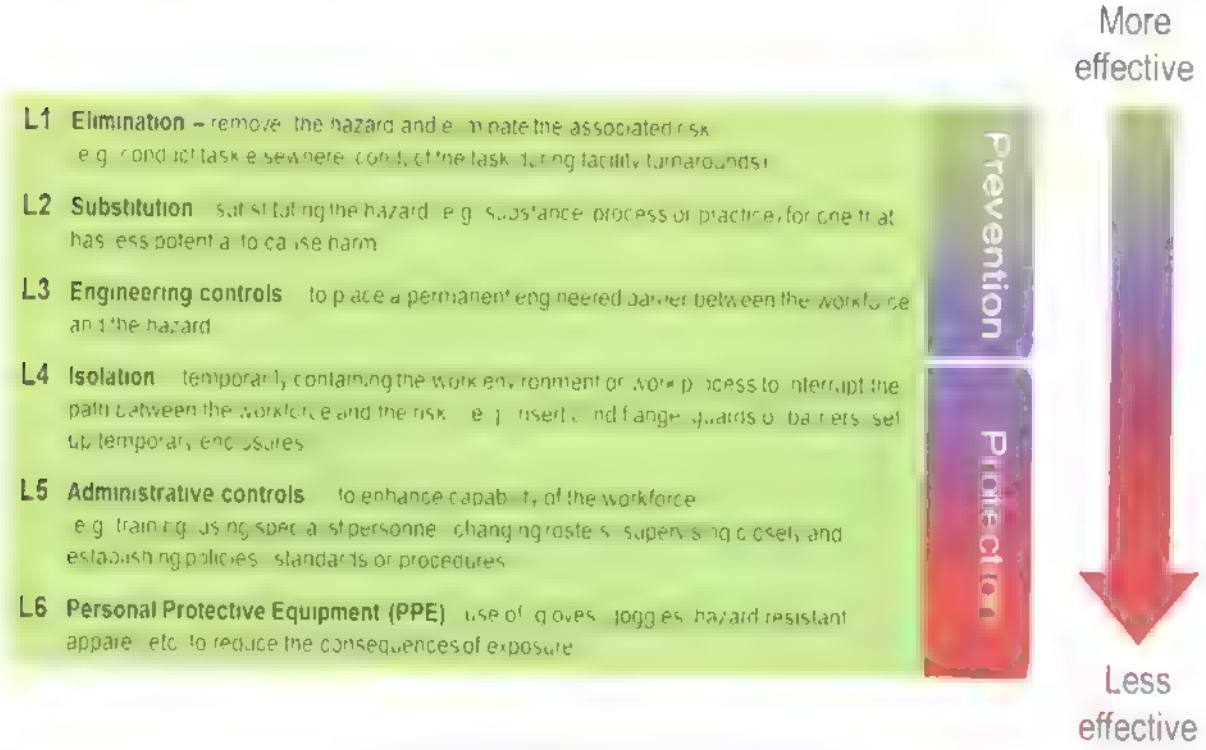


Figure 8. Risk Hierarchy of Control (HoC)

Notes; Selecting the most appropriate risk treatment option(s) involves balancing the potential benefits derived in relation to the achievement of the objectives against costs, effort or disadvantages of implementation.
Risk treatment options are not necessarily mutually exclusive or appropriate in all circumstances.
Risk treatment can also introduce new risks that need to be managed.

Reliability of Control Measures:

Controls should be assessed according to their reliability based on the following guide shown in Table 6. Reliance upon administrative or procedural controls alone may be appropriate for interim short-term interventions, but should not form the basis for longer-term risk reduction plans.

Control types	Examples	Increasing reliability
Passive measures	Preventing a shore tank from overflowing during a discharge operation from a ship by installing a tank that is larger than the ship's capacity.	↑
Active measures	Preventing a shore tank from overflowing during a discharge operation from a ship by installing a high-level shutdown system.	
Administrative or Procedural controls	Preventing a shore tank from overflowing during a discharge operation from a ship by relying on operator monitoring and control.	

Table 6: Control Types

Annex F - Risk Assessment Fundamentals

This appendix provides some basic guidance on risk assessment including:

a. When an assessment might be required.
b. What are the minimum expectations?
c. Basic steps that comprise an assessment and common pitfalls.

This appendix is intended to support the risk assessment step of the risk process. If assessing risk and no alternative definitive process is considered appropriate then the basic steps described here can be used as a guide.

1. When are risk assessments done:

Risk assessments are done for many reasons, including:

a. Regulatory requirements.
b. Holding Companies' requirements (e.g., in connection with a MOC).
c. Supporting divestment and acquisition decisions.
d. Identify if the risk is sufficiently managed or f further reductions are necessary.
e. Supporting decisions on project selection and design options to support ISD.
f. Supporting prioritization of risk reduction options.
g. Supporting decisions in design or operations.
h. Reviewing changes to operations.
i. Reviewing risks associated with the delivery of activities and consider what, if any, changes in the plan are needed.
j. Supporting deviation/dispensation requests to review and consider what, if any, additional mitigations are needed to support the deviation/dispensation.
k. Site selection.

In general, the purpose of risk assessments is to stop and to think about potential risk scenarios before proceeding with a business or operational decision.

2. Key features of a risk assessment

In the context of the risk management process (i.e., when assessing risk for inclusion in a risk register) the following can be considered attributes of a well-conducted risk assessment:

a. **Documentation:** Risk assessments are documented in a structured and systematic way.
b. **Purpose:** The purpose of the assessment is clearly understood by those involved in the risk assessment.
c. **Team composition:** A risk assessment involves:
   - More than one person.
   - At least one person is familiar with the process or activity.
   - At least one person who is independent enough from the decision-making role to adequately challenge the design or operation.
d. **Appropriate input:** The inputs to a risk assessment include relevant:
   - Basis of design
   - Drawings and diagrams.
   - Procedures.
   - Consequence analysis (if available).
   - Historical data.
   - Other data to support the assessment.
e. **Methodology:** Different methodologies are used depending on the purpose of the assessment

3. Steps in a risk assessment

Risk assessments typically comprise the following steps:

a. **Hazard identification:** Identify the hazards (i e., energy sources) and what could go wrong if the hazards are not controlled (e.g., hydrocarbon released, vessel listing or well kick to the surface).
b. **Scenario development:** Consider the causes that could result in loss of control of the hazards.

The taxonomy or bow-ties might be helpful in this step.

c. **Consequence assessment** (using the 6x6 risk matrix to assign an impact level).

This might be supported by a formal consequence analysis (e.g., fire analysis) or based on the experience and judgement of the assessment team.

d. **Likelihood assessment** (using the 6x6 risk matrix).

This step may be supported by relevant incident or historical data and so be semi-quantified or quantified (e.g., FTA or ETA) or be based on the judgement of the assessment team.

e. Mapping the output to the 6x6 risk matrix.
f. Identify risk reduction measures.

The first step in identifying risk reduction measures is to apply ISD principles to the activity being assessed to either eliminate the hazard or change the way that activity will be performed. If this is not possible or impracticable, then barriers are identified.

g. Consider temporary risk reduction measures, if needed, to manage the risk while longer-term solutions are developed.

For example, if assessing a barrier failure that requires repair or replacement

h. Consider if any further risk reduction is needed. This will depend on:
   - *Any specific requirements of the study methodology (e.g., HAZOP).*
   - *Whether regulatory and company requirements are being met.*
   - *Support of leadership based on the risk level.*

4. Risk reduction measures (barriers)

Risk reduction measures (barriers) can be targeted at different aspects of the hazard and risk event. They have different effects on the likelihood or consequences depending on what they are intended to do.

Barriers can be aimed at one of four ways of reducing the risk:

a. Barriers that can prevent the cause from progressing to an event (e.g., re-route the well trajectory to avoid a shallow gas zone).
b. Barriers that can prevent the event from happening (e.g., change the casing or cement design to ensure a strong section extends fully through the shallow gas zone).
c. Barriers that can mitigate the consequence (e.g., ignition control system to prevent a fire or explosion from starting).
d. Barriers that can mitigate the impact (e.g., alarms and evacuation systems to remove people from the vicinity as quickly as possible).

Barriers that prevent the cause or event reduce the likelihood. Barriers that mitigate the consequence or impact reduce the impact. Generally, prevention barriers are considered to be preferred and can be more effective than mitigation barriers.

5. Post-processing of the risk assessment

After a risk assessment has been completed there are several steps to follow:

a. Consider if the risk assessment has identified any new or changed risks that might either be missing or need to be updated in the risk register.
b. Review the risk ranking from the risk assessment against the risk ranking of similar events in the risk register for consistency. If inconsistencies are identified one of the following is done:

- Review and revise the risk assessment
- Update the risk ranking in the risk register

6. Recommendations from risk assessments

If a risk assessment identifies recommendations to improve the management of the risk then:

a. Recommendations are documented and followed up using the processes established by the segment or operating function.
b Recommendations should be able to deliver a demonstrable reduction in risk
c. Recommendations should be Specific, Measurable, Accountable, Realistic and Time-bound (i.e., 'SMART') and not duplicate existing actions.
d. Recommendations can be included in existing risk management plans in the risk register, if applicable.

7. Pitfalls in risk assessments

Some potential pitfalls in risk assessments include:

a. Team members who are either:
   - Not familiar with the process or activity being assessed.
   - Driving an agenda that is inconsistent with the goals of the assessment.
b. Too few or too narrow a range of team members can lead to risk consequences or likelihoods being under or overestimated if the team has no direct experience or knowledge of more significant events occurring.
c. Having too small or too big a team can result in insufficient support, a lack of full understanding of the risk, or the assessment getting bogged down with comments.
d. Using the assessment to justify an answer that has already been determined leading to not adequately reviewing the hazards, scenarios, and risks.
e. Failing to follow up on recommendations resulting in a false sense that risks are being managed and which can then create a backlog of actions.
f. Making recommendations that will not achieve demonstrable risk reduction because it is perceived to that is a necessary part of the process to make some recommendations.
g. Too narrow a scope can lead to the team failing to identify hazards that originate from a different area or activity that might result in a consequence for the area being considered.
h Using "cookie-cutter" techniques that assume one process is similar enough to another to avoid completing a full assessment.
i. The overthinking likelihood and consequence analysis, the purpose of which is primarily to set priorities and judge where to apply funds and resources.
j. Not doing a risk assessment in the first place.
k. Not confirming assumptions concerning barriers that might give risk reduction value when the barrier is not appropriate for the risk.

Annex G - Roles and Responsibilities

1. Risk Champion:

A "Risk Champion" shall be assigned and held responsible for the following:

- Energizing and facilitating the risk management activities.
- Overall management and custodian of the risk register and quality assurance of the data contained therein.
- Providing information as needed on the risk management process promptly to inform decision making.
- Providing training in the risk management process, including how to populate and maintain risk events in the risk register and produce reports, how to clearly and adequately describe risk events, how to assess risks and how to create effective risk reduction measures.
- Facilitating risk workshops.

2. Risk Accountable:

A "Risk Accountable" shall be assigned to each risk event with accountability to manage it, typically, they are responsible for:

- Describing the risk event in the risk register.
- Assessment of the risk event so that its priority for action can be understood.
- Developing any additional risk reduction measures, where needed, and seeking resources to implement those measures.
- Monitoring the status of the risk
- Updating the risk register for that risk.
- Liaise with the Risk Champion to ensure timely closure of the risk
- Identifying the Action Owner
- Follow-up with the action owners (Updating, Closing, etc.....)

3. Action Owner:

Assigned by risk accountable, typically they are responsible for:

- Implementing the action plan or their assigned part of it.
- Achieving the deliverables within the agreed timeline.
- Reporting progress to the risk accountable.
- Advising the risk accountable as soon as possible, if the action plans or their assigned part of it may not be met, to facilitate effective intervention.

Annex H - Risk Management Review Committees

Below is the recommended high-level governance structure for Risk Management Committees at different Risk Levels:

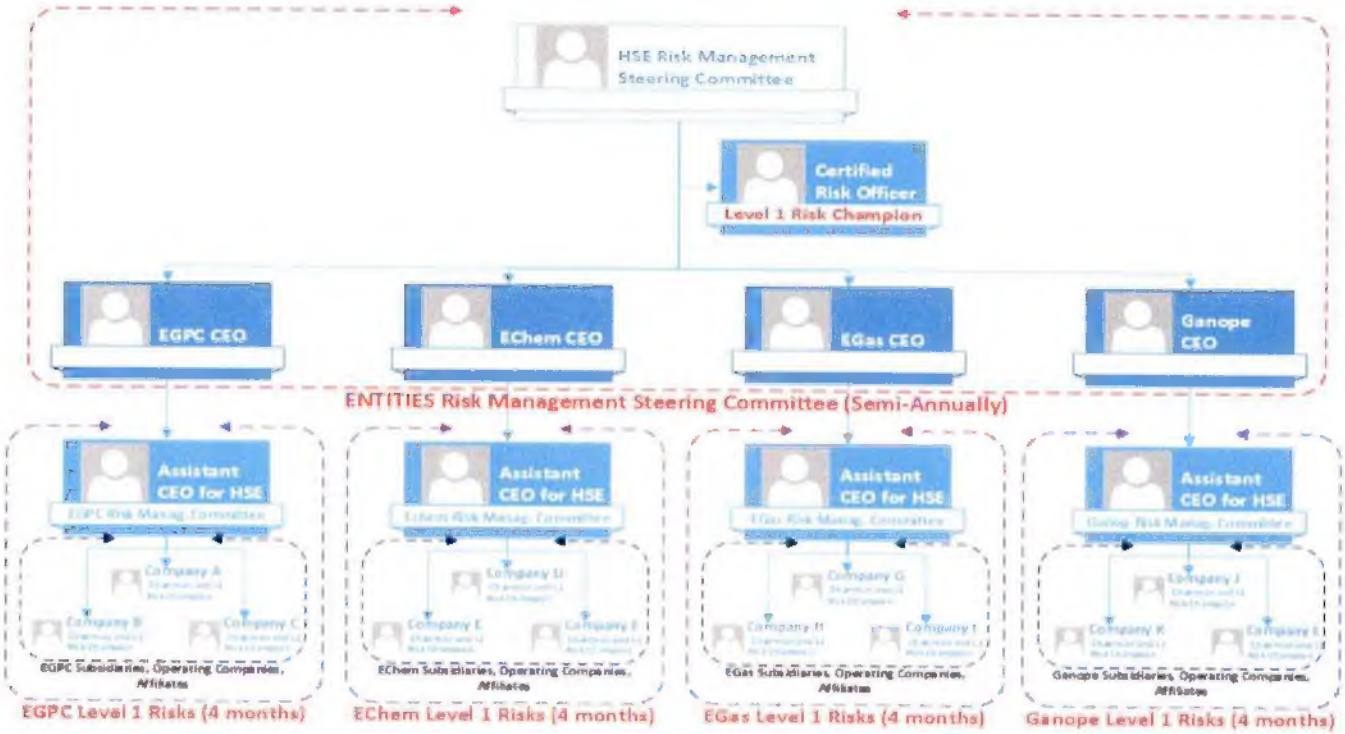


Figure 9: Typical Organization for Strategic Level Risk Management

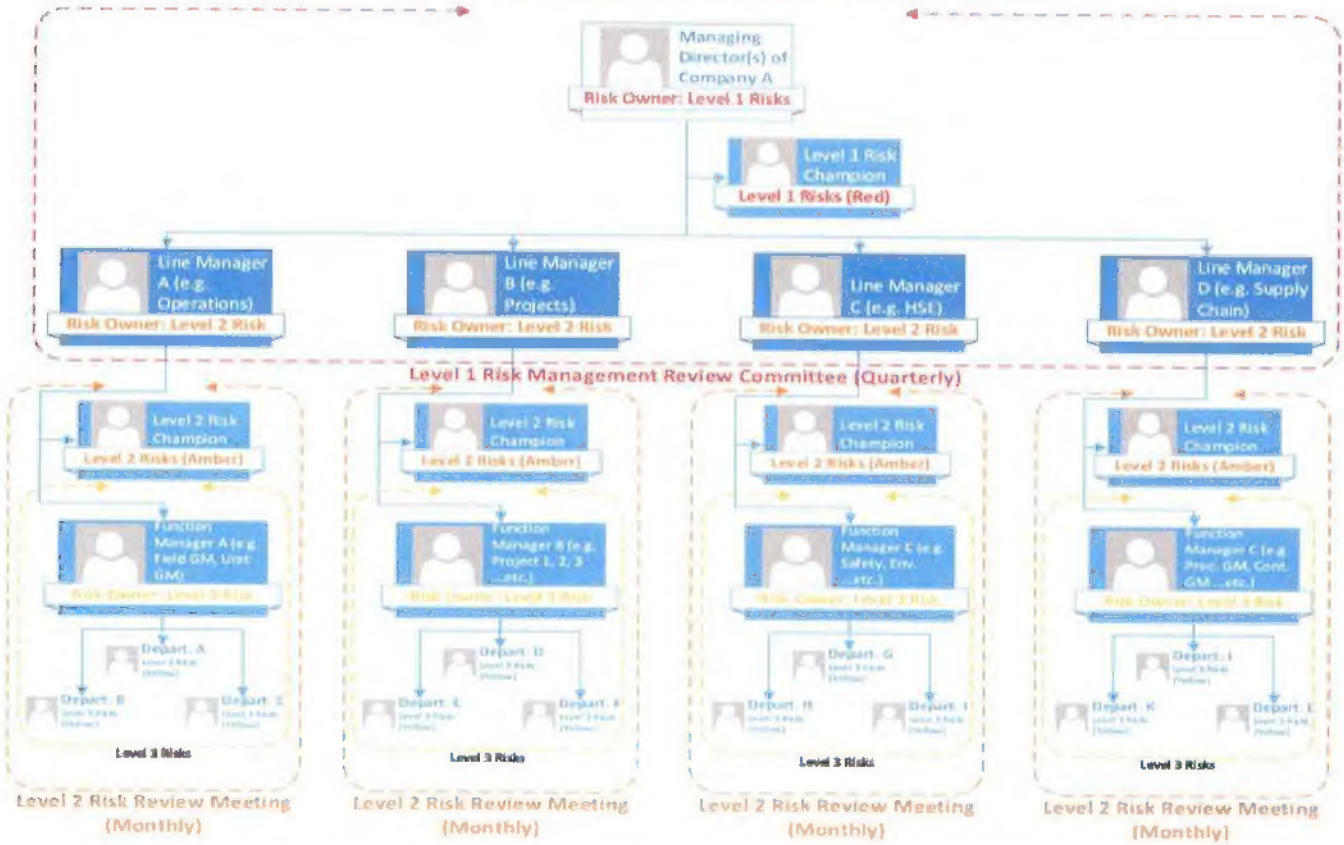


Figure 10: Typical Organization for Tactical/Operational Level Risk Management

Table 7: Recommended Risk Management Meeting Frequency

Level	Frequency	Who Shall Attend	Discussion/Outcomes
1	Semi-Annually [ENTITIES Level]	HSE Risk Management Steering Committee involving: - CEO of ENTITIES - CEO Assistant for HSE - Level 1 Risk Champion (Certified Risk Officer) - Other nominated by the Steering Committee	- Discuss the Level 1 risks escalated from relevant Holding Companies. - Discuss the potential for common initiative(s) across the sector to tackle common risks - Suggest a high-level recommendation to be cascaded across the sector - Review the risk profile across all sectors and for all segments
2	Quarterly [ENTITY Level]	Each ENTITY's Risk Management Committee involving: - CEO of ENTITY - CEO Assistants for (HSE, Operations, Projects, Finance ...etc.) - Level 1 Risk Champion (Certified Risk Officer) - Other nominated by the Risk Management Committee	- Discuss Level 1 risks received from COMPANIES. - Monitoring status of existing controls and any short-term actions in place. - Discuss the potential for common initiative(s) across the COMPANIES to tackle common risks. - Suggest a high-level recommendation to be cascaded across the COMPANIES. - Review the risk profile of the Holding Company across all segments.
3	Quarterly [COMPANY Level]	Chairman, Managing Director(s), Level 1 Risk Champion, Line Managers and Level 2 Risk Champions (if invited).	- Review response actions Plans. - Assess the effectiveness of mitigation plans. - Review HSE & Business Level 1 risk registers - Discussion on Identified risk ranking. - Agree on risk mitigation measures. - Actions Deferrals.
4	At least bi-monthly and might be conducted more frequently based on the risk status changes. [COMPANY Level]	Level 2 Risk Champions, Line and Department Managers & Project / Plant managers	- Assess/reassess risks. - Review response actions Plans. - Assess the effectiveness of mitigation plans. - Review & Updated HSE & Business Level 2 risk registers - Action/Risk Closure and deferral
5	Monthly, Operational Risk Review [COMPANY Level]	Level 3 Risk Champions, Project or Plant Manager, Risk accountable, Action Owners, Level 2 Risk Champion & Project / Operation Team	- Assess/reassess Risks - Review response actions Plans. - Assess the effectiveness of Response plans. - Review & Updated HSE & Business Level 3 risk registers - Review actions progress and due dates

Annex I - Signoff requirements for various residual risk levels

Risk Level	Action	Signoff Authority
1	• Immediate action is required to reduce the risk to tolerable levels and ALARP must be demonstrated for the control actions taken. • A hierarchy of control shall be adopted while selecting risk reduction measures. Engineering controls shall be the preferred risk reduction measures in the hierarchy. • Immediate site management notification and action required; site management shall escalate the finding to a higher level of management immediately. • Short-term risk reduction measures that will reduce the risk level to 'Amber' or less must be put in place immediately. • Additional short term risk reduction measures that will reduce the risk level to 'Amber' or less must be put in place as soon as practicable. • Permanent (long-term measures) to reduce the risk level to 'Amber' or less must be implemented within a specified time.	**Chairman / Managing Director(s) / VP's / CEO / Key Officers** (Consultation with appropriate SME required)
2	• Site management notification and action required. • A hierarchy of control shall be adopted while selecting risk reduction measures. Engineering controls shall be the preferred risk reduction measures in the hierarchy. • All attempts should be made to reduce the risk level to 'Yellow' or less. • Risk reduction measures to reduce the risk level to 'Yellow' or less must be implemented within a specified time.	**Senior Manager / Line Manager** i.e., Operations GM, Projects GM, Drilling GM, Financial GM, HSE GM ...etc.
3	• If practical, reduce the risk to a risk level 'Green'. • Demonstrate ALARP and ensure controls are in place and effective to maintain a risk level within ALARP and verified periodically. • Permanent risk reduction measures (if required) must be implemented within a specified time approved by site management.	**Site Managers / Project Managers / Function GM** i.e., District GM, Refinery Unit GM ...etc.
Green	• Monitor to ensure procedures and controls to maintain a risk level is effective	**Area Authority / Department Managers** i.e., OIM, Production Manager, Maintenance Manager ...etc.

For site/activity-based risk assessments such as risk assessments as part of PTW/CoW processes (Task Risk Assessments, HITRA, Job Safety Analysis, etc.), risk assessment as part of preventive maintenance deferral (temporary defeat), override management etc., signoff requirements shall be as per signoff authority levels established in those processes.